

1 "Apparatus and a Method for Use in Handling a Load"

2

3 This invention relates to apparatus for use in  
4 handling a load which is capable of raising and  
5 lowering, or of towing, a load and also handling  
6 service cables and/or hoses connected to the load.

7 The invention is particularly, but not exclusively,  
8 applicable to the handling of subsea equipment such  
9 as grabs.

10

11 Providing services to underwater equipment often  
12 involves the provision of a specific bundle of  
13 cable(s) and/or hose(s) dedicated to each  
14 application. For some applications, it is known to  
15 incorporate the service bundle within an armoured  
16 hoist rope. This approach has a number of  
17 deficiencies. The resulting rope is costly, gives  
18 inferior hoisting properties, and by virtue of  
19 limitations on the diameter of rope which can be  
20 handled, the services that can be incorporated are  
21 limited. Further, in practice it is impossible with  
22 this arrangement to add to the length of the rope or

1 to join different types of materials, for example  
2 wire ropes with fibre ropes.

3  
4 To avoid the necessity of using the expensive  
5 armoured hoist rope, it is known to wind a service  
6 cable around a rope, or vice versa, to service  
7 underwater equipment. However, due to water  
8 currents and/or movement of a ship from which the  
9 apparatus operates, the service cable and rope are  
10 placed under stress, which can cause the service  
11 cables and the rope to pull away from each other,  
12 and the service cable to slip or creep down the  
13 rope.

14  
15 According to an aspect of the present invention  
16 there is provided apparatus for use in handling a  
17 load comprising a load-bearing rope, a mechanism for  
18 paying out and recovering the load-bearing rope, a  
19 service cable and a service cable holder for holding  
20 the service cable, a first wrapping device for  
21 rotating one of the service cable and the load-  
22 bearing rope around the other as they are payed out  
23 to wrap the two together, and to unwrap them from  
24 one another as they are recovered, a mechanism for  
25 holding and paying out a securing member, and a  
26 second wrapping device for wrapping the securing  
27 member around the service cable and the load-bearing  
28 rope, and to unwrap the securing member from the  
29 service cable and load-bearing rope as either of  
30 them is recovered.

31

1 The securing member is wound around the service  
2 cable and the hoist rope, to hold the service cable  
3 relative to the load-bearing rope and to reduce the  
4 extent of creeping of the service cable down the  
5 load-bearing rope.

6  
7 The securing member can be planar, in the form of a  
8 strip, tape or ribbon, or can have a circular cross-  
9 section, in the form of a rope. In preferred  
10 embodiments, the securing member is resilient and is  
11 applied to the rope in tension.

12  
13 The term "service cable" is used herein to denote a  
14 flexible elongate member used for conveying power or  
15 data, such as an electrical cable, a fibre optic  
16 cable, or a pneumatic or hydraulic hose.

17 Typically, the first wrapping device comprises a  
18 service cable drum being arranged for rotation about  
19 a drum axis which coincides with the axis of the  
20 rope. The cable may be guided by sheaves or pulleys  
21 from the drum. Instead of rotating on its axis,  
22 cable drum may be static and may have a winding  
23 device rotating around it to pay out the service  
24 cable. Preferably, the service cable drum has a  
25 central aperture through which the load-bearing rope  
26 passes.

27  
28 The service cable drum may be rotatably mounted on a  
29 structural member so that its axis is not co-  
30 incident with the axis of the rope, and so that it  
31 is moved in a circular path around the axis of the  
32 rope as the cable is being paid out or recovered.

1 Sheaves and/or pulleys may again guide the cable as  
2 it is being paid out or recovered. The axis of the  
3 service cable drum in such embodiments can be  
4 vertical so that it is parallel to the axis of the  
5 rope, or horizontal, so that it is perpendicular to  
6 the axis of the rope.

7  
8 Optionally, the cable drum has an axis which  
9 coincides with the axis of the load-bearing rope,  
10 the cable drum typically having a central aperture  
11 through which the load-bearing rope passes, with the  
12 service cable passing over a cable sheave which is  
13 mounted for movement in a circular path around the  
14 axis of the load-bearing rope.

15  
16 Optionally, the securing member drum has an axis  
17 which coincides with the axis of the load-bearing  
18 rope, the securing member drum typically having a  
19 central aperture through which the load-bearing rope  
20 passes, the securing member passing over a rope  
21 sheave which is mounted for movement in a circular  
22 path around the axis of the load-bearing rope.

23  
24 Optionally, the first and second wrapping devices  
25 include respective arms arranged for rotation about  
26 the load-bearing rope. Optionally, the arms support  
27 spooling gear.

28  
29 Preferably, the securing member leaves the securing  
30 member drum and any associated sheaves radially  
31 outward of the service cable to wind the securing

1 member around the service cable and the load-bearing  
2 rope.

3  
4 Preferably, the securing member has elastic  
5 properties. Typically, the securing member is made  
6 of neoprene with a nylon reinforcing strip or  
7 sheath. The securing member can have a nylon  
8 reinforcing strip woven into it to limit the maximum  
9 extension of the member, or can be sheathed in  
10 nylon. The securing member may be planar, and may  
11 incorporate an adhesive to hold the securing member  
12 to the rope.

13  
14 Typically, the mechanism for paying out and  
15 recovering the load-bearing rope includes a rope  
16 winch, from which the load-bearing rope passes over  
17 a rope sheave and thereafter extends to the load  
18 along a substantially straight axis.

19  
20 Optionally, the rope winch, the cable drum, the  
21 securing member drum, and any winding devices each  
22 have a respective driving motor. Alternatively, the  
23 rope winch, the cable drum, the securing member drum  
24 and any winding devices are driven by a single  
25 source through appropriate mechanical linkages.

26  
27 Typically, the service cable and/or the securing  
28 member are payed out close to the axis of the rope.

29  
30 Typically, the service cable comprises an electrical  
31 cable, a fibre optic cable, a pneumatic cable or a  
32 hydraulic hose.

1 Preferably, the load-bearing rope is a hoist rope  
2 used for raising and lowering a load. Typically,  
3 the load-bearing rope is a towing rope used for  
4 paying out, towing and recovering a load.

5

6 Optionally, more than one service cable is provided,  
7 each typically extending from a respective drum.

8

9 Optionally, the cable drum and the securing member  
10 drum are both coaxial with the load-bearing rope,  
11 one being positioned above the other and the load-  
12 bearing rope extending through the centre.

13 Alternatively, one of the cable drum and the  
14 securing member drum is coaxial with the load-  
15 bearing rope and the other is arranged for movement  
16 in a circular path around the rope on a winder  
17 mechanism. Alternatively, neither the cable drum  
18 nor the securing member drum is coaxial with the  
19 load-bearing rope and both are moved in a circular  
20 path around the rope on winder mechanisms. In any  
21 of these cases, the axes of the cable and securing  
22 member drums can be either parallel to or  
23 perpendicular to the axis of the hoist rope.

24

25 Preferably, the apparatus also includes a guide  
26 means for guiding the load-bearing rope.

27

28 Typically, the guide means comprises at least one  
29 roller or sheave. Preferably, more than one roller  
30 is provided. Optionally, four rollers are provided  
31 around the circumference of the rope forming a  
32 roller cage which encloses the load-bearing rope.

1 According to a second aspect of the present  
2 invention there is provided a method for use in  
3 handling a load, comprising:

4  
5 paying out a load-bearing rope;  
6 paying out a service cable;  
7 wrapping one of the rope and the service cable  
8 around the other as they are being paid out;  
9 wrapping a securing member around the service cable  
10 and load-bearing rope as they are being paid out;  
11 and subsequently unwrapping the securing member and  
12 service cable from the load-bearing rope as the  
13 load-bearing rope is recovered.

14  
15 Preferably, the securing member is wound around the  
16 load-bearing rope in the opposite direction to the  
17 service cable, typically over the top of the service  
18 cable.

19  
20 Winding the service cable and the securing member in  
21 opposite directions could more strongly fix the  
22 service cable to the load-bearing rope.

23  
24 Optionally, the securing member is wrapped around  
25 the rope and service cable(s) only at intervals  
26 along the rope, but in most embodiments the securing  
27 member is wrapped continuously down the length of  
28 the rope as it is payed out. Such intermittent  
29 wrappings can comprise discrete lengths of rope,  
30 tape or ribbon, optionally formed of elastic  
31 material and optionally with an adhesive element, in  
32 order to avoid the need to wrap the securing member

1 continuously around the rope and cable. In some  
2 embodiments, the tape can be applied intermittently  
3 on top of the securing member, so that there are  
4 several layers of securing member at certain points  
5 on the rope, for example at the lower end of the  
6 rope that will be at the deepest depths. Typically  
7 the tape is applied at intervals eg every 100 - 300  
8 metres.

9  
10 Examples of apparatus and a method for use in  
11 handling a load in accordance with the invention  
12 will now be described with reference to the  
13 drawings, in which:-

14  
15 Fig. 1 is a schematic perspective view  
16 illustrating the principle of operation of a  
17 first example of the invention;  
18 Fig. 2 is a side view showing details of a part  
19 of the apparatus of Fig. 1;  
20 Fig. 3 is a cross-section view of an embodiment  
21 of Fig 1;  
22 Fig. 4 is a cross-section view of an  
23 alternative embodiment of Fig. 1;  
24 Fig. 5 is a schematic perspective view of a  
25 second example of the invention;  
26 Fig. 6 is a more detailed side view of a part  
27 of Fig. 5;  
28 Fig. 7 is a cross-section view of an embodiment  
29 of Fig. 5;  
30 Fig. 8 is a cross-section view of an  
31 alternative embodiment of Fig. 5; and



1           Fig. 9 is a schematic perspective view of Fig.  
2           1, adapted for towing rather than lifting.

3  
4       Referring to Fig. 1, a hoist rope 1 extends from a  
5       hoist rope winch 13 over a hoist rope sheave 4 to  
6       support a load (not shown) for raising and lowering.  
7       The hoist rope 1 may be any suitable form of hoist  
8       rope such as flexible steel wire rope or synthetic  
9       fibre rope, for example of "Kevlar". A service  
10      cable 2 is held on a service cable drum 3, which is  
11      rotatably mounted around the rope 1. One end of the  
12      cable 2 extends from the drum 3 and is wound around  
13      the rope 1. A securing member in the form of a  
14      planar strip 17 of elastic material such as neoprene  
15      is held on a rope drum 30, which is also rotatably  
16      mounted for movement in a circular path around the  
17      rope 1. An end of the strip 17 extends from the  
18      rope drum 30 and is wound around the entwined rope  
19      and service cable 2, preferably at a different pitch  
20      or in a different direction. The drums 3, 30 are  
21      preferably rotatable independently of each other,  
22      but they could be rotatable together. Additional  
23      service cables could be wound around the hoist rope  
24      1 from additional respective drums rotatably mounted  
25      around the hoist rope 1. The securing member drum  
26      30 should be mounted to wrap the strip 17 around the  
27      only or outer service cable 2 (i.e. on an arm which  
28      extends outward of the service cable drum(s)).

29  
30      The strip 17 is preferably elastic, but this is not  
31      essential. Certain preferred forms of securing

1 member such as the strip 17 can also be tacky or  
2 adhesive

3

4 Fig. 2 shows a more detailed view of the connection  
5 of the cable drum 3 with the rest of the apparatus.  
6 The service cable drum 3 is removably mounted on a  
7 hub motor 11 which is carried on the end of an arm  
8 18 rotatably mounted on a fixed frame 20 and driven  
9 by a motor 10. The frame 20 is attached to the rope  
10 sheave 4.

11

12 Fig. 3 is also a more detailed version of Fig. 1,  
13 also showing the strip drum 30. The strip drum 30  
14 is attached to the end of an L-shaped arm 6. The  
15 arm 6 has a horizontal limb 6a extending radially  
16 from the axis of the apparatus to a point outward of  
17 the cable drum 3 and a vertical limb 6b on the end  
18 of which the strip drum 30 is located, to suspend  
19 the strip drum 30 radially outward and below the  
20 cable drum 3. This ensures that the securing member  
21 17 is always wound the top of the service cable 2  
22 and that the securing member 17 and the cable 2 do  
23 not become entangled.

24

25 In use, the winch 13 is rotated to lower the hoist  
26 rope 1. At the same time, the motor 10 is activated  
27 to rotate the arm 18 around the hoist rope 1, and  
28 the arm 6 is also rotated (typically by its own  
29 similar motor arrangement, or it may be powered from  
30 the motor 10). The arm 6 is typically rotated in  
31 the opposite direction to the arm 18, which rotates  
32 the cable drum 3 and the strip drum 30 around the

1 hoist rope 1, to wind the strip 17 around the hoist  
2 rope 1 in the opposite direction to the winding of  
3 the service cable 2. The service cable 2 is thus  
4 entwined around the hoist rope 1 which is attached  
5 to a load, and the strip 17 is wound around the  
6 entwined hoist rope 1 and cable 2. Thus, the hoist  
7 rope 1 can take the strain of an object lifted  
8 without placing the service cable 2 under strain,  
9 and the strip 17 binds the service cable 2 to the  
10 hoist rope 1, preventing it from slipping down the  
11 hoist rope 1.

12

13 In most preferred embodiments the strip has an  
14 elastic component and is applied to the rope in  
15 tension, so that once applied the strip keeps the  
16 cable close to the rope. The tension applied to the  
17 strip by e.g. a self tensioning device on the  
18 wrapping mechanism is not generally sufficient to  
19 overcome the tension in the main hoist rope, and so  
20 does not affect the assembly of the rope, cable and  
21 securing member.

22

23 To recover the hoist rope 1 and the service cable 2,  
24 the procedure is simply reversed. The direction of  
25 the motor(s) is reversed to rotate the arms 6, 18 in  
26 the opposite directions, to wind the service cable 2  
27 and the securing member 17 back onto their  
28 respective drums. If tape has been used, this is  
29 unwound or cut (by hand or automatically) from the  
30 entwined ropes/cable(s).

31

1     Fig. 4 shows an alternative embodiment, where the  
2     securing member drum 30 is located on top of the  
3     horizontal limb 6a. The securing member 17 extends  
4     over the limbs 6a and 6b, guided by guides 9, 11,  
5     which are typically sheaves or rollers. The guide 9  
6     is at the apex of the arm 6; guide 11 is on the end  
7     of the vertical limb 6b. The securing member 17  
8     extends from the guide 9 towards the rope 1 on the  
9     exterior of service cable 2, in a similar way to the  
10    Fig. 3 embodiment.

11

12    Fig. 5 shows a schematic diagram of an alternative  
13    embodiment. In this modification, the service  
14    cables 2 and the securing member 17 are each  
15    provided with a respective storage drum 16, 15  
16    stacked on top of each another with their axes  
17    parallel to the axis of the rope 1. The service  
18    cable 2 and the securing member 17 each have a  
19    respective sheave 5, 14 which may suitably be  
20    carried on a common supporting frame for rotation in  
21    unison. Alternatively the frames may be separate so  
22    that the sheaves 5, 14 can rotate independently of  
23    one another. The apparatus may be further modified  
24    by adding further drums and sheaves to handle more  
25    service cables.

26

27    Fig. 6 shows the cable drum 16, the member drum 15  
28    and associated parts in greater detail. The rope  
29    sheave 4 is journaled to a fixed frame 20 that is  
30    secured to any suitable supporting structure such as  
31    an A-frame (not shown). The member drum 15 and the

1 cable drum 16 are rotatably mounted one above the  
2 other on the lower part of the frame 20.

3

4 The inner end of the service cable 2 can be  
5 connected to any appropriate service if needed by  
6 any convenient means (not shown) but is otherwise  
7 connected to the cable drum 16.

8

9 The member drum 15 is driven in rotation by a motor  
10 6. Optionally, a shaft (not shown) passes through  
11 the centre of the member drum 15 and the shaft  
12 meshes with a cog engagement mechanism inside the  
13 bore of the member drum 15 to rotate the member drum  
14 15. The cable drum 16 is could be driven in  
15 rotation by a separate motor (not shown);  
16 alternatively, the cable drum 16 could be driven in  
17 rotation from the motor 6. This could be done from  
18 an inner shaft, inside the shaft that drives the  
19 member drum 15, connecting inside the bore of the  
20 cable drum by a similar engaging cog mechanism. A  
21 gear mechanism would preferably be provided to  
22 rotate the inner shaft in the opposite direction to  
23 the outer shaft.

24

25 The member sheave 14 is journalled on a mounting  
26 frame 9 that is rotatable about the fixed frame 20  
27 by means of a motor 7. Likewise, the service cable  
28 sheave 5 is journalled on a mounting frame 50 that  
29 is rotatable about the fixed frame 20. Again, the  
30 service cable sheave 5 could be driven in rotation  
31 from the same motor 7 via an interior shaft and  
32 cogs, or from a separate motor (not shown).

1 The motors 6 and 7 are driven at speeds related to  
2 the axial speed of the hoist rope 1. The speed  
3 correlation may be fixed. Preferably, however, this  
4 correlation will be controllable to alter both the  
5 length of twist (pitch) of the lay of the member 17  
6 on the hoist rope 1, and the tension in the securing  
7 member 17. The pitch and the lay of the cable 2 on  
8 the hoist rope 1 will also be controlled in a  
9 similar way, whether these are controlled by the  
10 same motors 6, 7 or different ones not shown.

11  
12 Fig. 8 shows a more detailed view of the embodiment  
13 of Fig. 5. The service cable 2 extends from the  
14 rope drum 16 over guides 32, 34 to pass the service  
15 cable 2 around the lower lip 36 of the service cable  
16 drum 16 without dragging on the lip 36. The guides  
17 32, 34 are located on an arm (not shown) adapted for  
18 rotation around the cable drum 16, as shown in Fig.  
19 6.

20  
21 Likewise, the securing member 17 extends over a  
22 second L-shaped arm 6 (only the vertical portion of  
23 the arm is shown) over guides 9, 11. In this  
24 embodiment the securing member is in the form of an  
25 elasticated rope. The guides 9, 11 are typically  
26 rollers or sheaves. The arms are preferably  
27 rotatable independently of each other.

28  
29 After passing over their respective guides, service  
30 cable 2 and securing member 17 extend towards the  
31 hoist rope 1 to wind around the rope 1, as in the  
32 other embodiments.

1 Fig. 7 shows an embodiment similar to that of Fig.  
2 4, but having the rope drum 15 positioned around the  
3 hoist rope 1, with its axis aligned with the hoist  
4 rope's axis. The service cable 2 extends over a  
5 rotatable arm (not shown) and over guides 32, 34,  
6 which are typically rollers or sheaves, as shown and  
7 described above for the Fig. 8 embodiment.

8  
9 Fig. 9 illustrates the example of Fig. 1 modified  
10 for use in a marine towing application, for example  
11 in paying out, towing and recovering a sensor array  
12 such as a sonar sensor or seismographic surveying  
13 sensor, the sensor array being towed underwater or  
14 on the surface. The service cable drum 3 is hinged  
15 to the main structure of the towing vessel (not  
16 shown) and can be tilted to a desired towing angle  
17 by hydraulic or other mechanisms.

18  
19 Other modifications may be made within the scope of  
20 the invention. For example, the positions of the  
21 hoist rope 1 and the service cable 2 could be  
22 reversed so that the hoist rope 1 is on a drum and  
23 the cable 2 is fed from a winch, to wind the hoist  
24 rope 1 around the service cable 2. When tension is  
25 put on the hoist rope 1, the hoist rope 1  
26 straightens and the service cable 2 becomes wound  
27 around the hoist rope 1 in any case.

28  
29 More service cable drums could be provided: in the  
30 embodiment of Fig. 1, further service cable drums  
31 could be provided rotatably mounted around the hoist  
32 rope 1; in the embodiment of Fig. 5 there could be

1 further arms extending radially outward of the hoist  
2 rope 1 axis, each with a respective cable sheave.

3

4 Further rollers and/or guide sheaves could be used  
5 to conveniently position the cable relative to the  
6 rope, e.g. to deflect one away from the axis of the  
7 other, or to pass the cable around the lip of an arm  
8 to align the cable with the rope.

9

10 The securing member 17 is preferably wrapped around  
11 the hoist rope 1 in the opposite direction to the  
12 wrapping of the outer or only service cable 2, but  
13 this is not essential, and the securing member could  
14 be wrapped onto the rope and cable at a different  
15 pitch to the cable. Tape could also be wrapped  
16 around the entwined cable/ropes, either at intervals  
17 or in a long continuous length. To unwind the  
18 cable/ropes, the tape may be unwrapped or cut  
19 therefrom.